

## CLAIMS

1. A method for optically switching/routing comprising the steps of:

separating input optical radiation into distinct input channels;

selecting desired distinct output channels;

propagating said distinct input channels through a selectable grating based switching/routing sub-system in order to direct said distinct input channels to desired distinct output channels;

recombining said desired distinct output channels.

2. The method of claim 1 wherein the step of separating input optical radiation comprises the step of utilizing a separating sub-system comprising a pair of separating gratings; and,

wherein the step of recombining said desired distinct output channels comprises the step of utilizing a recombining sub-system comprising a pair of recombining gratings.

3. The method of claim 1 wherein the step of separating input optical radiation comprises the step of utilizing a separating sub-system comprising at least one Array Waveguide Grating (AWG); and,

wherein the step of recombining said desired distinct output channels comprises the step of utilizing a recombining sub-system comprising at least one Array Waveguide Grating.

4. The method of claim 1 wherein the grating based switching/routing sub-system comprises a volume holographic grating based switching/routing sub-system.

5. An optical switching/routing system comprising:  
an optical separating sub-system;  
said optical separating sub-system being capable of separating input optical radiation from at least one input beam/port into distinct input channels;  
an optical recombining sub-system;  
a selectable free space grating based switching/routing sub-system, said selectable switching and routing sub-system being interposed optically between said optical separating sub-system and said optical recombining sub-system; and;

said selectable switching/routing sub-system being capable of switching/routing said distinct input channels to desired distinct output channels;

said optical recombining subsystem being capable of redirecting and recombining said desired distinct output channels for output into at least one output beam/port.

6. The optical system of claim 5 wherein said selectable switching/routing sub-system includes at least one pixellated switchable component.

7. The optical system of claim 5 wherein said optical separating sub-system comprises a first separating diffraction grating, and a second separating diffraction grating; and,

wherein said optical recombining sub-system comprises a first recombining diffraction grating, and a second recombining diffraction grating.

8. The optical system of claim 7 wherein at least one of said first separating diffraction grating, said second separating diffraction grating, said first recombining diffraction grating, and said second recombining diffraction grating comprises a fixed grating.

9. The optical system of claim 7 wherein at least one of said first separating diffraction grating, said second separating diffraction grating, said first recombining diffraction grating, and said second recombining diffraction grating comprises a volume holographic grating.

10. The optical system of claim 7 wherein said first separating diffraction grating is substantially parallel to said second separating diffraction grating, and, said first recombining diffraction grating is substantially parallel to said second recombining diffraction grating.

11. The optical system of claim 4 wherein said selectable switching/routing sub-system comprises a switchable grating based sub-system.

12. The optical system of claim 9 wherein said switchable grating based sub-system comprises a planar switchable grating based sub-system.

13. The optical system of claim 4 wherein said selectable switching and routing sub-system comprises a switchable mirror based sub-system.

14. The optical system of claim 11 wherein said selectable switching and routing sub-system comprises a planar switchable mirror based sub-system.

15. The optical system of claim 4 wherein said optical separating sub-system comprises an Array Waveguide Grating (AWG); and,

wherein the optical recombining sub-system comprises an Array Waveguide Grating.

16. The optical system of claim 13 further comprising at least one microlens array.

17. The optical system of claim 13 further comprising anamorphic optics for circularizing the waveguide outputs of the separating AWG.

18. The optical system of claim 4 further comprising:  
means operably connected to said selectable switching and routing sub-system for controlling the state of each pixels from a plurality of pixels;

said controlling means being capable of enabling the selecting of desired distinct output channels.

19. An optical switching/routing sub-system comprising:

first diffractive grating means for receiving and directing each of a plurality of input beams of electromagnetic radiation to travel in free space along a predetermined path of a plurality of separate paths to a predetermined output location of a plurality of output locations; and

second diffractive grating means;

said first diffractive grating means comprising a plurality of substantially evenly spaced apart switchable transmissive diffractive gratings and each of said spaced apart switchable transmissive diffractive gratings having at least one separately switchable region; and

said at least one said separately switchable region of said switchable diffractive gratings capable of being selectively activated or deactivated in order to independently control which said predetermined path of said plurality of separate paths at least one of said plurality of input beams of electromagnetic radiation travels in free space;

said second diffractive grating means receiving a plurality of output beams from said plurality of output locations and redirecting said output beams, said plurality of redirected output beams being substantially parallel to said plurality of input beams.

20. The optical switching and routing sub-system of claim 19 wherein said second diffractive grating means comprises a fixed grating.

21. The optical switching and routing sub-system of claim 19 further comprising a reflector array;

a location of said second diffractive grating means being substantially coincident with extensions of substantially evenly spaced apart switchable transmissive diffractive gratings; and

wherein said reflector array further redirects said plurality of output beams ensuring that said plurality of output beams remain separated.